Appendix B. Remarks on the teleological problem

The mechanistic paradigm is very reluctant to assume the emergent, intuitively "obvious" property that living beings act with agency, purposively, teleologically, with self-directed functionality and with meaningful processing of information directed toward their interests. We did not wish to enter into this debate in depth in this text, although in our opinion, Gaia, precisely because she is an organism, would have as much teleology (or more) than "objects" that we characterize as living organisms, be it a bacterium or a Michaelensis termite mound. Thus, we use "she" instead of "it" to characterize Gaia not with the intention of equating her with a human-like "she," but with the intention of reinforcing her character as an individual organism (in this case, unique), since in language we tend to use a "he" or a "she" for a "special" living animal or plant individual (such as a "pet" or a gardener's favourite flower).

The scientific community, including Lovelock himself, used to confound the teleological phenomenon, i.e. the capacity to have goal-directed behaviour, objectives, purposes and anticipation, with the phenomenon of human self-awareness, foresight and planning capacity during many decades (Doolittle's critique to the Gaia hypothesis (Doolittle, 1981)). However, recently some efforts have been made to reinitiate the debate on organisms' teleology such as in (Lenton et al., 2020; McShea, 2023; Noble and Noble, 2023; Weber and Varela, 2002). Lenton et al. state: "the teleological dimension of Gaia must be confronted directly, rather than being avoided to please biologists" (Lenton et al., 2020, p. 266).

Within the biological and ecological realm of experimental and observational biologists, it is common to study higher-level structures as autonomous from the quantum particles and atoms they are made of. This contrasts with a reductionist approach that rejects top-down causation and emergent properties, where everything would ultimately be reducible to physics. However, a standard reductionist framework struggles with explaining scientific observations beyond physics and chemistry (e.g., biology, neurology, etc.) because this paradigm refuses to acknowledge the emergent property of intrinsic teleology—namely, that organisms (or for the case of humans, the human mind) coordinate their parts for their benefit and purpose, even though organisms (and the human mind) emerge from these parts. The parts work for the whole that coordinates them. For example, we cannot describe the atomic processes that compel a stork to build its nest without invoking teleological emergent properties—i.e., the stork's *purpose*. Consciousness of the stork in a human sense is not required to speak of purpose. The stork drives its parts and directs the creation and movement of its complex molecules to perform the actions required to fulfill that purpose. Arguably, to assume that only atomic-level physical processes exist is a hypothesis far more difficult to defend than assuming the existence of purpose, as the latter not only describes reality but also enables predictions that the purely reductionist approach cannot achieve (e.g., by observing the stork's beak, we can predict the type of context in which it operates).

There are no bottom-up models or theories "above" quantum physics that do not start from aggregate entities with emergent properties that are often difficult to define. A clear example is the reductionist use in biology of the concept of the gene, whose "behavior" has emergent properties that its parts do not have. It has even been described as "selfish" (Dawkins 1979), in a clearly absurd way if the expression is taken beyond a metaphorical sense, when it is itself supposed to be a piece of a complex molecule. For consistency with the mechanistic-reductionist paradigm, which struggles to speak of emergent properties, genetics should be discussed only from the perspective of quantum mechanics. Even in physics we work with continually emerging properties, with terms that cannot be attributed to atoms: temperature, viscosity, friction... which although we say arise from the statistical properties among electronsticles - which we cannot see nor work directly with, like is the case of the "quarks" -

no scientist analyses the friction of skis on snow from a quantum perspective, but rather starts from "friction coefficients" that we directly "measure" as an emergent property of statistic averages of electromagnetic interactions among electrons and quarks.

While the 'purpose' of a machine is designed from the exterior of the machine (by the human engineer) the purposeful character of living beings is intrinsic and could be the emergent characteristic that defines organisms (de Castro 2019).

We assume that Gaia has at least the same teleological properties as any organism, if not more, since the transfer of functions (speaking of function is actually speaking of teleology, since the "by and for" is used) is toward Gaia. The cells of the human body lose functionality within themselves, and an "external" agent coordinates them functionally for that external agent, the body. Thus, they tend to lose their intrinsic teleological character. In the appendix (and also in de Castro 2019), we hold that intrinsic teleology is a defining characteristic of life, perhaps even equivalent to what is being alive.

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